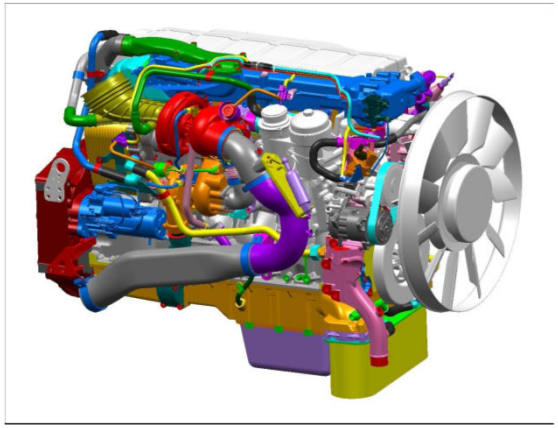
Lehrstuhl für
Verbrennungskraftmaschinen
Prof. Dr. Rudolf Flierl

PROMESCON GmbH

Double-Fuel

(DFMC)

mixture combustion



Diesel-Engines

with additional CNG, LNG, LPG or Bio-Gas

Injection

Professional Management & Engineering
Senior Consulting

Double Fuel the solution

- With the new measure of Double Fuel mixture combustion it is possible to reduce 50% of sued emission and 20% of Co2 Emission in every Diesel Engine even the old and long running trucks can be modified.
- The system has been developed together with the Professorship of KaiserslSutern in Germany and has been successfully proven now several times in Trucks and busses.
- The mixture burning process is replacing up to 65% Diesel by CNG (Compressed Natural Gas) or by LNG (Liquid Natural Gas) LPG Liquid Propane Gas or even by Bio-Gas!
- It is possible to implement this system in existing trucks as well as new trucks produced in future.
- All stationary Engines in every fixed or mobile application can be retrofitted by this system.
- The homogeneous combustion could save the environment and the recourses of oil in the world. Scientists found out, that the durability of oil recources will survive the next 50 to 70 years but the Gas reserve will survive more than 300 Years.

Double Fuel the Business

Double Fuel can become a multi billion dollar business, because:

- somebody has to measure the Engine Type and to program the new software for the application,
- somebody has to develop and produce the electronic device,
- somebody has to develop the retrofitting system.
- Somebody has to modify the service stations to “Double Fill systems”,
- somebody has to educate the service people
- somebody has to implement the system into a Truck.
- If you assume, that 2 people can modify one Truck in 5 days and you have only 1 Million Trucks to modify, it means, that they would need 5 Mio. Days to modify or 10 000 people would need 500 Working days for the modification. But there is much more. These people have to be educated and certified first and there are much more than 1 Mio Trucks and Diesel Cars in the USA.

- **Somebody has to produce the retrofitting systems!**

- The modified trucks would save the environment from millions of tonnes of sued emissions, Co2 and NOx emissions.

Double Fuel impact (DFMC)

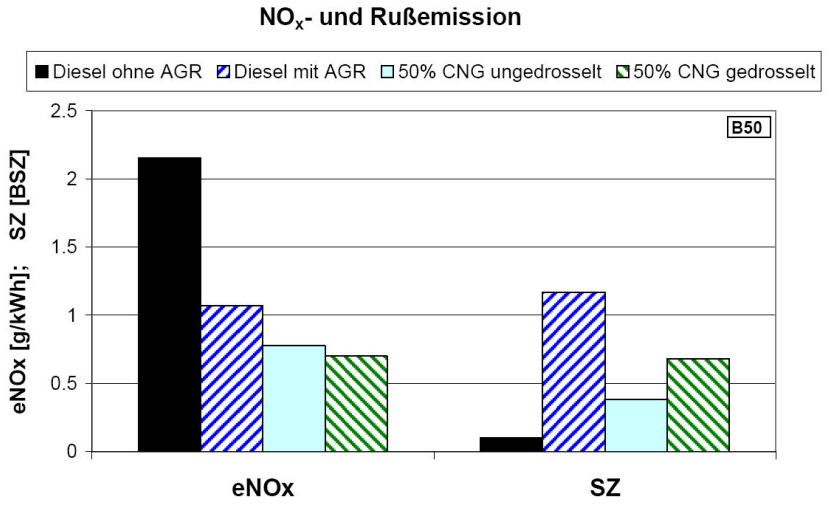
- **Emissions of diesel engines** contain high values of Nitrogen Oxides (Nox) and Particulate Matter (PM)
- Due to more **strikter emission requirements** it is necessary to reduce emissions of Truck Engines to at least Euro3 Standard.
- Leading countries with the **highest standards** in Emmissions are Europe and Japan with EPA10 and EU5/6.

Double Fuel Mixture Burning (DFMC)

- It is **the most efficent technology** to reduce Particular Matter and NOx in Diesel engines.
- In any Diesel Engine it reduces →
  - **Running costs**
  - **CO_2 emissions**
  - **Particular emissions**
  - **NOx emissions**
- And improves any Engine easily to the required Standard!

NOx Emission

- Diesel burning is an inhomogenious process and the positive characteristic of the CNG, LNG or LPG is optimizing the mixture burning of Diesel and Gas to homogenious combustion.
- The emission on NOx, is tremendously reduced.

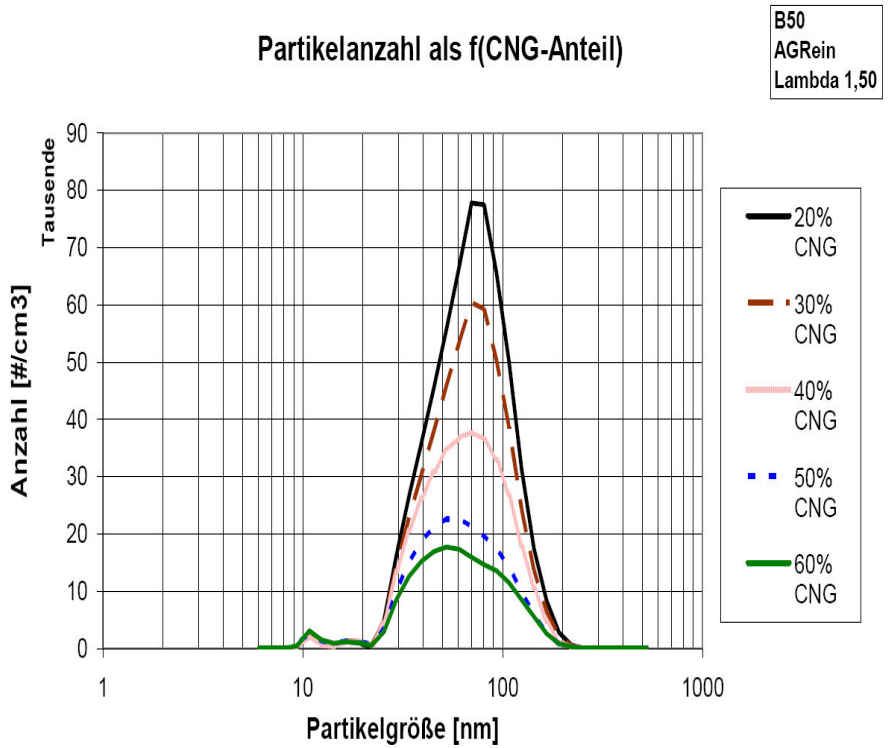


Co_2 Emissions

- Due to the use of CNG, LNG, LPG or Bio-Gas the CO_2 emissions will also be reduced, because the burning process of CNG, LNG or LPG is more residue free than any Diesel or Gasolin burning process. The result is approx. 20% less CO_2

Particular emissions

- The mixture burning process decreases and reduces the particular raw emissions by up to 50%.
- Due to this fact, a smaller Catalytic converter or particle filter can be used (Costs)



Diesel and Gas

- The new mixture burning process requires the similar fuel equivalent consumption to create **the same power, and the same torque as in mono Diesel operation**.
- **The major advantage of the mixture burning is the neutral behaviour for durability and lifetime of the standard engine, by simultaneously tremendously reduced emissions!**
- **A former Euro0 or Euro1 Engine can become a Euro3 Engine; a Euro 3 Engine can become a Euro4 or Euro5 Engine in respect of Sued emissions!**
- Complete conversion from Diesel to CNG, LNG or LPG destroys the standard engine after a short period of time!
- Engines with complete replacement from Diesel to CNG, LNG or LPG require approx. 30% more Fuel and reduce thereby the power and the torque by up to 30% Therefore it makes no sense to convert an Diesel Engine to a CNG, LNG or LPG Engine! Emissions will increase.
- For mixture burning no modification is needed in the basic Diesel engine.
- **The Double Fuel Technology is an Ad-on System and can be applied to any new or existing Engine.**

Reducing Fuel Costs

- In most countries the equivalent of energetically needed quantum of CNG, LNG is extremely cheaper than Diesel.
- In Germany and China it is more than 50€Cents per Litre
- You can replace up to 70% Diesel by CNG, LNG or LPG or BioGas

Other benefits of DFCM

- The mixture burning operation can be applied in any Diesel driven Vehicle. No matter what size and application.
- **It can be used as an ad-on system for existing Trucks and Busses.**
- It can be implemented in new Diesel driven Vehicles.
- It will help, by simple means, to improve existing Diesel Engines with Euro 0 or Euro 1 to easily reach Euro 3
- and can help to reach the required Euro standards by not especially for Euro 4 or Euro 5 designed engines.

Why Diesel and Natural Gas injection?

Impact for the environment:

- Diesel and Gas Mix Combustion is reducing tremendously CO_2, NOx and Carbon Particles
- Especially used in Urban and suburban Vehicles like Busses, Supply Transportation Vehicles, Trucks, Street Cleaning
- Typical reductions are: (According to the engine design):
- Minus 20% CO_2
- Minus 40% NOx on Raw Emission
- Minus 50% Carbon Particles (Sued Particles)

Diesel + CNG or LNG (Mixture combustion)

CNG, LNG, LPG, Bio-Gas,

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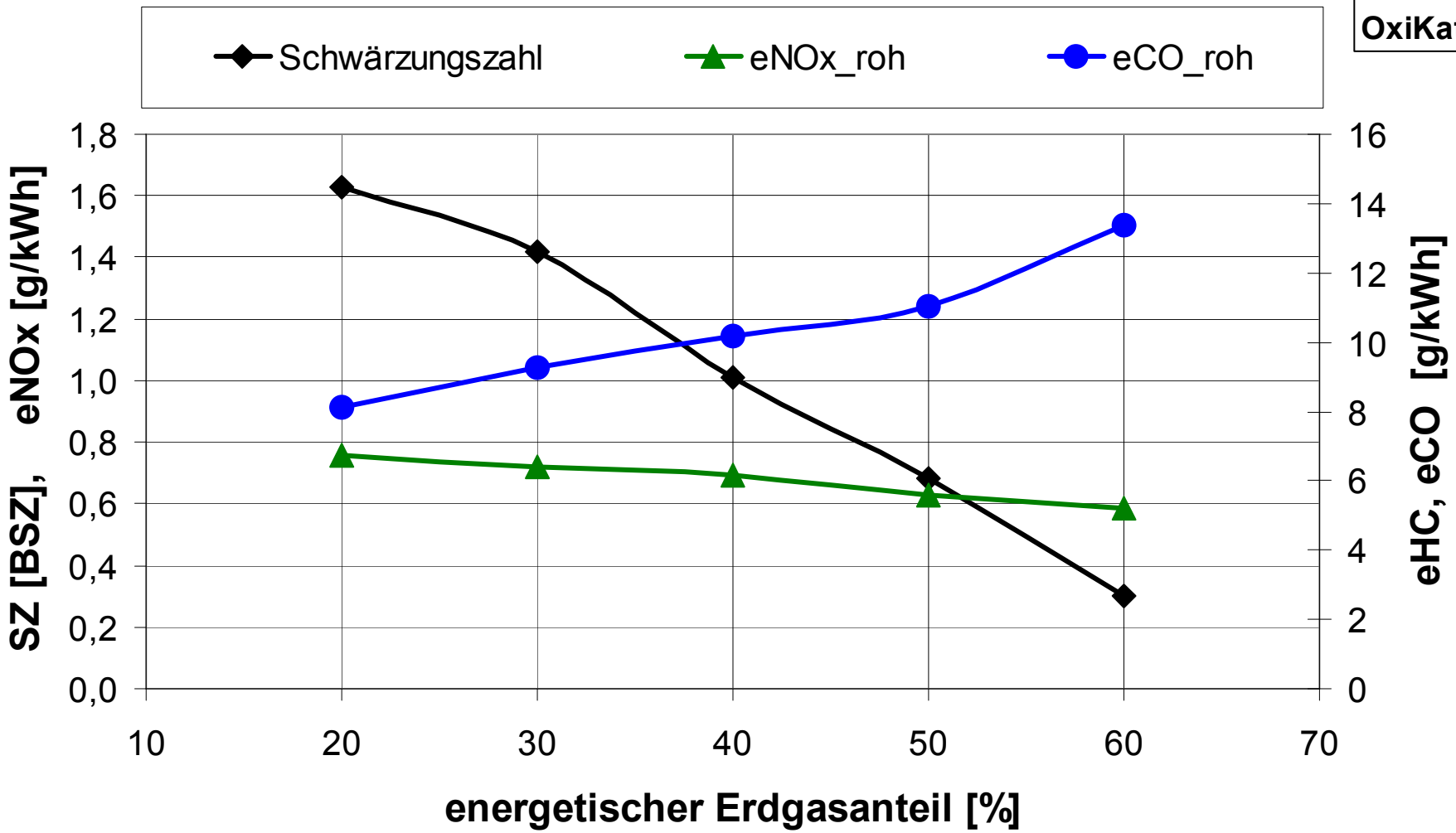
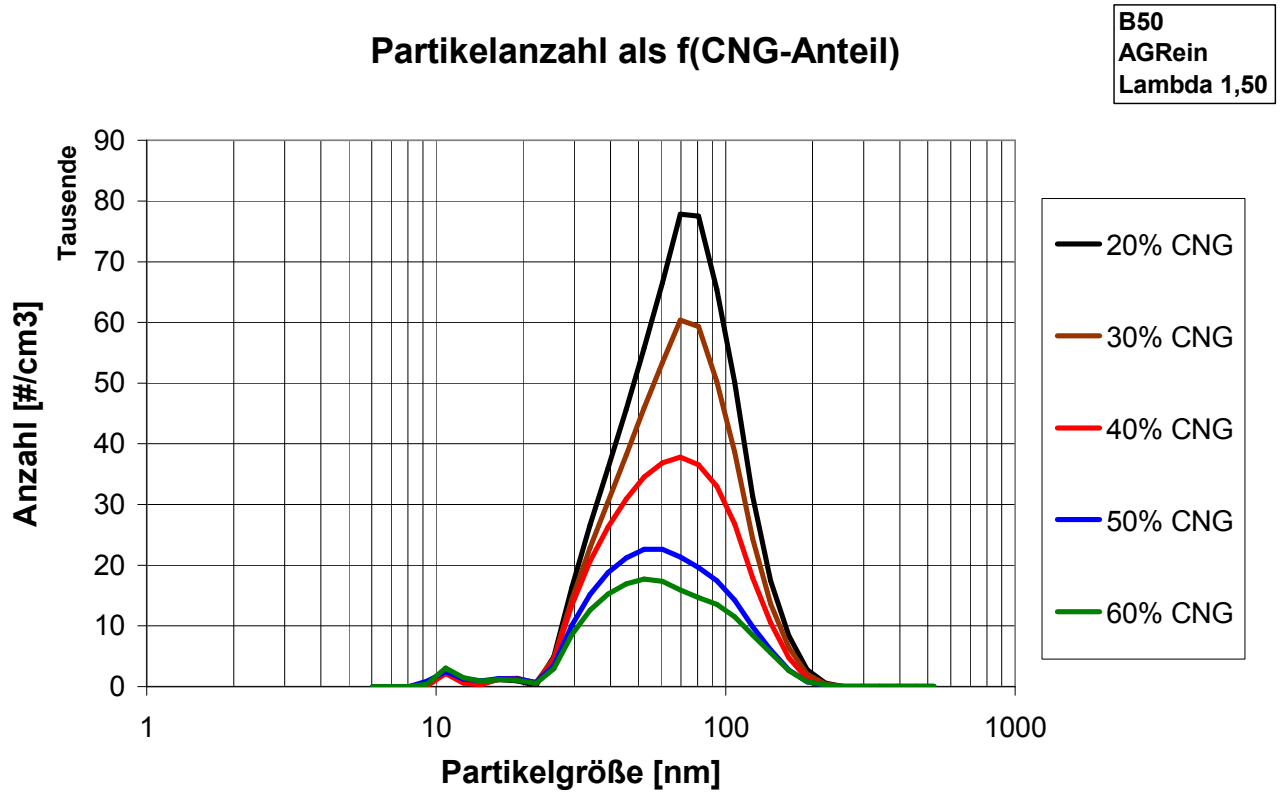
B50
Lambda 1,5
AGR ein
OxiKat

Emission als f(Erdgasanteil)

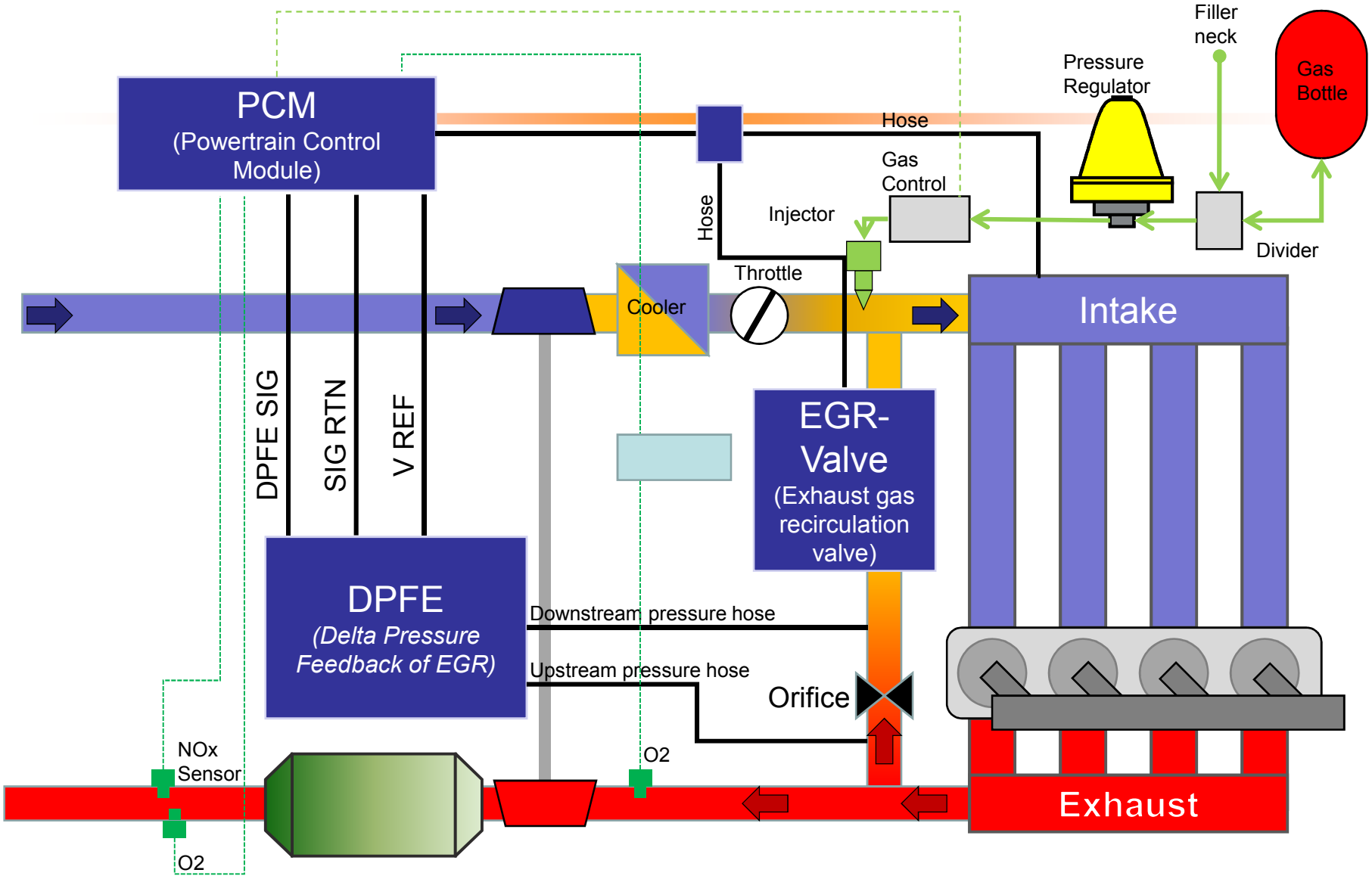


Measurements

Diagramm of reduced particle matter (PM)

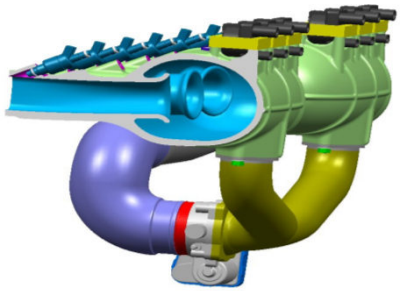


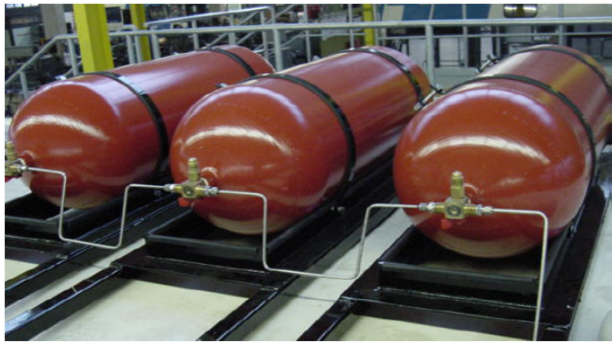
Diesel/CNG System configuration



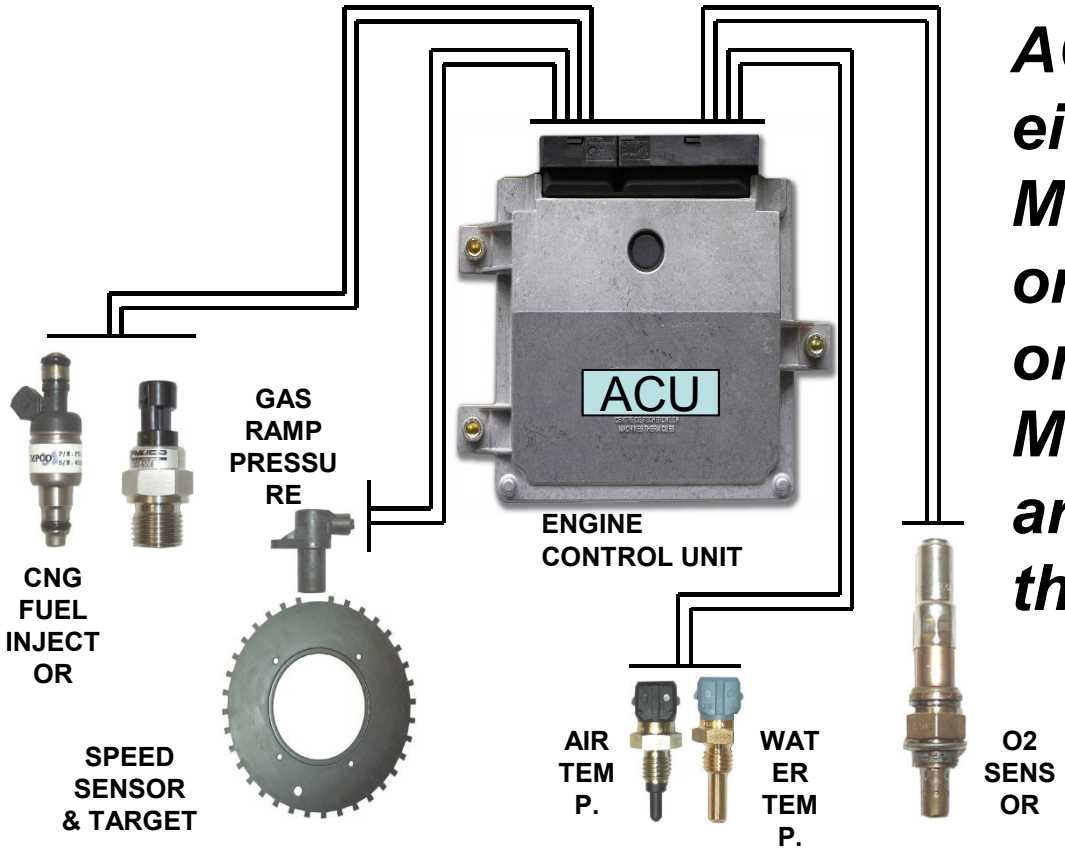
Specific mechanical components for Bus application

- Dedicated or modified inlet manifold, gas rail and injectors





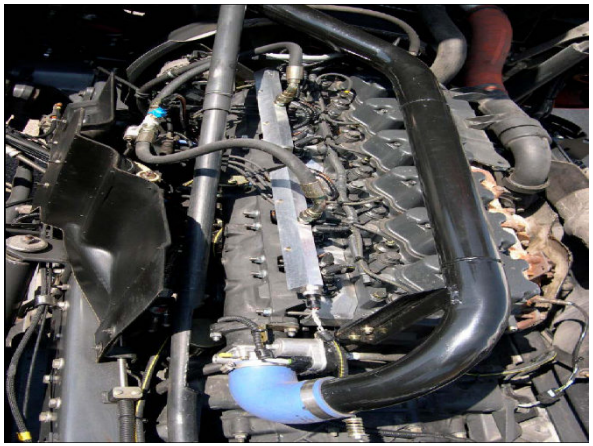
Adaptive Control Unit (ACU)



ACU Software can either be used in a Master Slave Function or be integrated in the original ECU.
Most sensors displayed are already existing in the car

Diesel/LNG conversion Sample

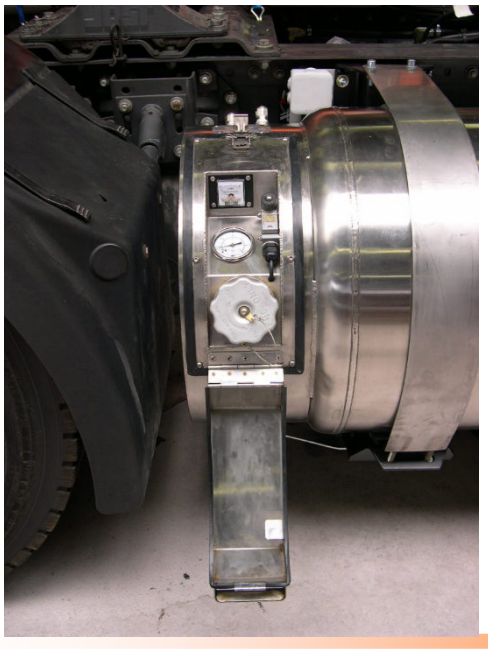
DFMC
a clean, safe and
cost effective solution
for Trucks and Busses

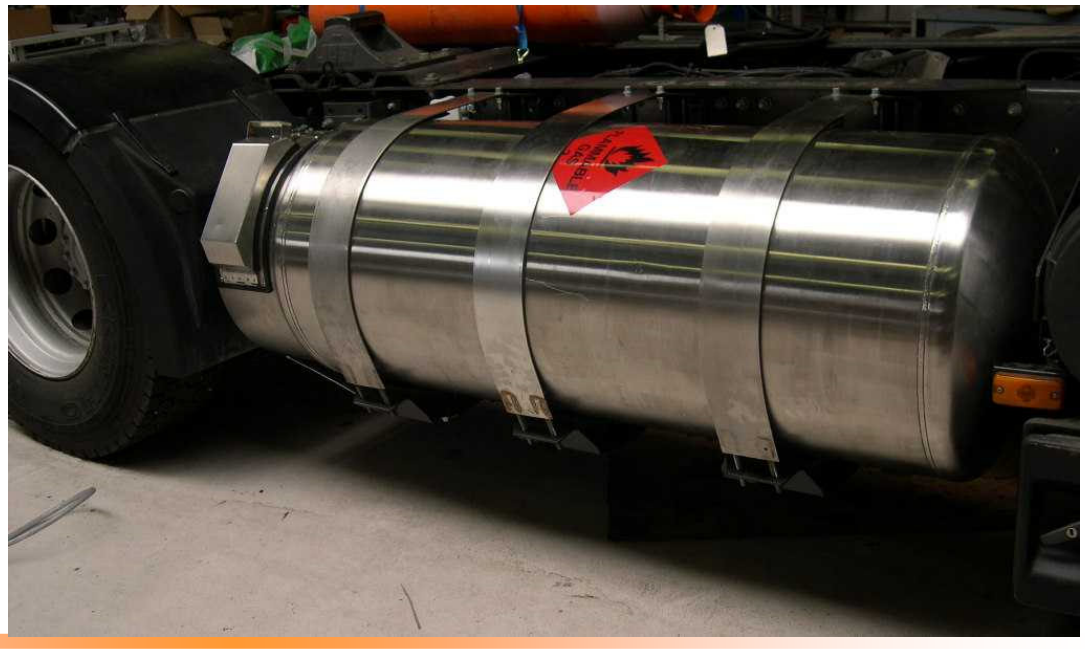


Vehicle conversion sample

The vehicle is equipped with all necessary Diesel/LNG feed components (fuel line, heat exchanger, pressure regulator)

The diesel fuel tank is replaced by a 200 l Cryogenic LNG tank





Conversion Sample Diesel/CNG/LNG

The Function has been proven in several applications. Busess are running perfectly and extremely economical since 5 Years.